

CLAIMS

1. A light modulator, comprising:
 - a substrate;
 - a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;
 - at least one electrode formed on the substrate adjacent the cavity; and
 - a liquid having an index of refraction greater than one disposed within the cavity,
 - wherein an interface of the liquid is oriented at an angle to a surface of the at least one electrode and oriented at an angle to a surface of the transparent plate,
 - wherein light is adapted to pass through and refract at the interface of the liquid.
2. The light modulator of claim 1, wherein the surface of the at least one electrode is substantially planar over an entirety thereof.
3. The light modulator of claim 1, wherein the surface of the at least one electrode is oriented substantially parallel with the surface of the transparent plate.
4. The light modulator of claim 1, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to the at least one electrode.
5. The light modulator of claim 1, wherein the transparent plate has an uneven surface including a plurality of recessed areas, wherein the interface of the liquid is provided along the uneven surface within the recessed areas.

6. The light modulator of claim 5, wherein the at least one electrode is associated with one of the recessed areas of the uneven surface.
7. The light modulator of claim 1, further comprising:
a transparent electrode formed within the transparent plate.
8. The light modulator of claim 1, further comprising:
a sidewall extended between the substrate and the transparent plate;
and
an additional electrode formed on the sidewall adjacent the cavity.
9. The light modulator of claim 8, wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.
10. The light modulator of claim 8, further comprising:
a hydrophobic coating formed over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall.
11. The light modulator of claim 10, wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.
12. The light modulator of claim 1, wherein the surface of the at least one electrode is a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.
13. The light modulator of claim 1, wherein the substrate is a transparent substrate and the at least one electrode is a transparent electrode, wherein the

light is adapted to pass through the transparent electrode and the transparent substrate.

14. A display device including the light modulator of claim 1.
15. An optical switch including the light modulator of claim 1.
16. A method of forming a light modulator, the method comprising:
spacing a transparent plate from a substrate, including defining a cavity between the transparent plate and the substrate;
forming at least one electrode on the substrate adjacent the cavity; and
disposing a liquid having an index of refraction greater than one within the cavity, including orienting an interface of the liquid at an angle to a surface of the at least one electrode and at an angle to a surface of the transparent plate,
wherein light is adapted to pass through and refract at the interface of the liquid.
17. The method of claim 16, wherein the surface of the at least one electrode is substantially planar over an entirety thereof.
18. The method of claim 16, wherein forming the at least one electrode includes orienting the surface of the at least one electrode substantially parallel with the surface of the transparent plate.
19. The method of claim 16, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to the at least one electrode.
20. The method of claim 16, further comprising:
forming the transparent plate with an uneven surface including a plurality of recessed areas,

wherein the interface of the liquid is provided along the uneven surface within the recessed areas.

21. The method of claim 20, wherein forming the at least one electrode includes associating the at least one electrode with one of the recessed areas of the uneven surface.
22. The method of claim 16, further comprising:
forming a transparent electrode within the transparent plate.
23. The method of claim 16, further comprising:
extending a sidewall between the substrate and the transparent plate;
and
forming an additional electrode on the sidewall.
24. The method of claim 23, wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.
25. The method of claim 23, further comprising:
forming a hydrophobic coating over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall.
26. The method of claim 25, wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.
27. The method of claim 16, wherein forming the at least one electrode includes forming the surface of the at least one electrode as a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid,

through the interface of the liquid, and through the surface of the transparent plate.

28. The method of claim 16, wherein the substrate is a transparent substrate, and wherein forming the at least one electrode includes forming the at least one electrode as a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

29. A light modulator, comprising:

- a substrate;
- a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;
- at least one electrode formed on the substrate adjacent the cavity;
- a liquid having an index of refraction greater than one disposed within the cavity; and
- means for orienting an interface of the liquid at an angle to a surface of the at least one electrode and at an angle to a surface of the transparent plate, wherein light is adapted to pass through and refract at the interface of the liquid.

30. The light modulator of claim 29, wherein the surface of the at least one electrode is substantially planar over an entirety thereof.

31. The light modulator of claim 29, wherein the surface of the at least one electrode is oriented substantially parallel to the surface of the transparent plate.

32. The light modulator of claim 29, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to the at least one electrode.

33. The light modulator of claim 29, wherein means for orienting the interface of the liquid includes an uneven surface of the transparent plate, the uneven

surface including a plurality of recessed areas and the interface of the liquid being provided along the uneven surface within the recessed areas.

34. The light modulator of claim 33, wherein the at least one electrode is associated with one of the recessed areas of the uneven surface.

35. The light modulator of claim 29, further comprising:
a transparent electrode formed within the transparent plate.

36. The light modulator of claim 29, further comprising:
a sidewall extended between the substrate and the transparent plate,
wherein means for orienting the interface of the liquid includes an additional electrode formed on the sidewall,
wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.

37. The light modulator of claim 36, wherein means for orienting the interface of the liquid further includes a hydrophobic coating formed over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall, and

wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.

38. The light modulator of claim 29, wherein the surface of the at least one electrode is a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

39. The light modulator of claim 29, wherein the substrate is a transparent substrate and the at least one electrode is a transparent electrode, wherein the

light is adapted to pass through the transparent electrode and the transparent substrate.

40. A method of controlling light with a light modulator including at least one electrode formed on a substrate, the method comprising:

 directing light through a transparent plate spaced from the substrate and through a cavity defined between the transparent plate and the substrate; and

 directing the light through a liquid having an index of refraction greater than one disposed within the cavity, including passing the light through and refracting the light at an interface of the liquid,

 wherein the interface of the liquid is oriented at an angle to a surface of the at least one electrode and oriented at an angle to a surface of the transparent plate.

41. The method of claim 40, wherein the surface of the at least one electrode is substantially planar over an entirety thereof.

42. The method of claim 40, wherein the surface of the at least one electrode is oriented substantially parallel to the surface of the transparent plate.

43. The method of claim 40, further comprising:

 applying an electrical signal to the at least one electrode and changing the index of refraction of the liquid.

44. The method of claim 40, wherein directing the light through the transparent plate includes directing the light toward an uneven surface of the transparent plate including a plurality of recessed areas, wherein the interface of the liquid is provided along the uneven surface within the recessed areas.

45. The method of claim 44, wherein the at least one electrode is associated with one of the recessed areas of the uneven surface.

46. The method of claim 40, wherein directing the light through the transparent plate includes directing the light through a transparent electrode formed within the transparent plate.

47. The method of claim 40, further comprising:
applying an electrical signal to an additional electrode of the light modulator, including moving the liquid toward the additional electrode and establishing the interface of the liquid at the angle to the surface of the at least one electrode.

48. The method of claim 47, wherein the at least one electrode and the additional electrode each have a hydrophobic coating formed thereover.

49. The method of claim 48, wherein applying the electrical signal to the additional electrode includes changing the liquid between a hydrophobic liquid and a hydrophilic liquid.

50. The method of claim 40, wherein the surface of the at least one electrode is a reflective surface, and further comprising:
reflecting the light with the reflective surface of the at least one electrode, including directing the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

51. The method of claim 40, wherein the at least one electrode is a transparent electrode and the substrate is a transparent substrate, and further comprising:

directing the light through the transparent electrode and the transparent substrate.